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(56) Documents cited
GB 2233512 A GB 1200707 A GB 1200702 A
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(58) Field of search
UK CL (Edition K) H2G GBX GDB GDE
INT CL[5] H01H

(54) High breaking capacity micro-fuse

(57) A high breaking capacity micro-fuse includes a body (1) having a wall which forms a cavity in the body (1), a pair of conductive terminals (3, 4) provided through the wall, and a fusible element (6) extending between the pair of conductive terminals (3, 4) and connected thereto in the cavity. An insulating member (2) with a hole through which the fusible element (6) extends has a shape by which a space is provided between the inner surface of the wall of the body (1) and the insulating member (2) when the insulating member (2) is disposed in the cavity of the body.

Fig. 2

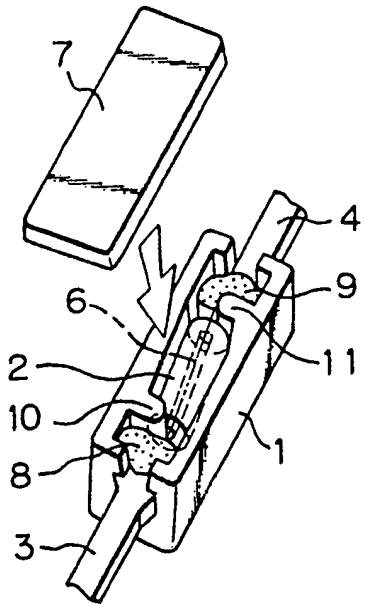

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Fig. 1

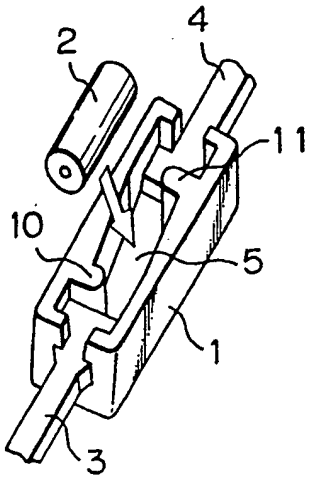


Fig. 2

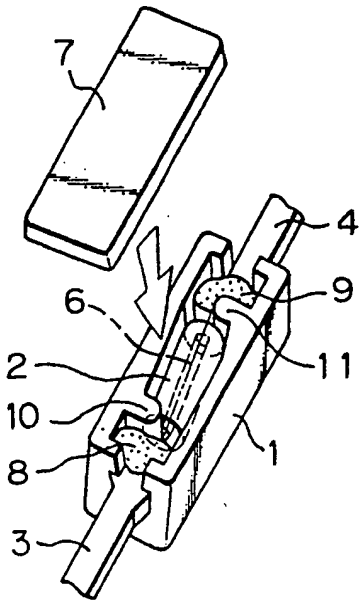


Fig. 3

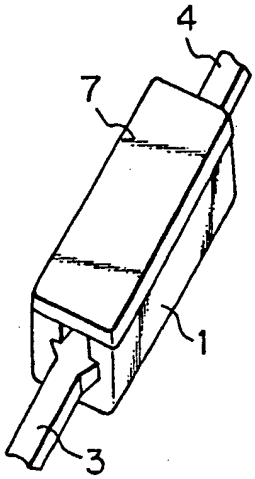


Fig. 4

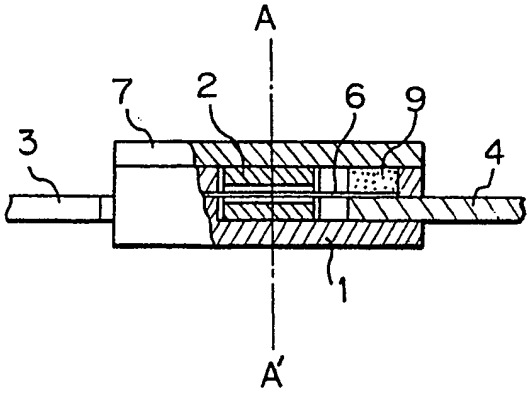
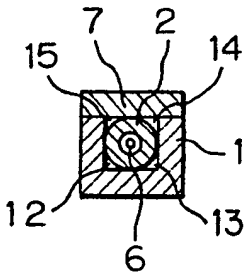


Fig. 5



HIGH BREAKING CAPACITY MICRO-FUSE

The present invention relates to a component for protecting components connected to an electric circuit against burning that may occur when abnormal overcurrent flows through the electric circuit.

Recently, there have been strong demands for the miniaturization of the electronic apparatus. In order to meet these demands, the length of wiring of a circuit on a printed board tends to be decreased with charging sections having opposite polarities tending to be placed in nearer proximaty to each other as well. Due to this, when compared with a case in which a conventional printed circuit board is used, a greater magnitude of abnormal current tends to flow once an accident of short-circuit occurs.

In order to cope with this, smaller circuit protecting components also have been demanded, and the distance between terminals of such smaller circuit protecting components has been decreased. In cutting off abnormal current, there is a close relationship between the occurrence of arc discharge and the magnitude of abnormal current and/or the distance between the terminals. The greater the magnitude of abnormal current becomes, or the smaller the distance between the terminals becomes, the more easily longer arc discharge occurs. Arc discharge generates heat having a high temperature of several thousands centigrade degrees, and due to this there is a risk of circuit protecting components themselves being

burnt. Thus, cutting off current becomes more and more difficult when trying to satisfy the demands for the miniaturization of circuit protecting components.

The present invention relates to a high breaking capacity fuse that is smaller, and which has a higher breaking capacity performance so that the above problem can be dealt with.

Conventionally, a fuse of this type is well known in which an arc-extinguishing material is packed around a fusible element so as to extinguish a high-temperatured arc that is generated after the fusible element has been fused by abnormal current.

In the fuse described above, since the arc-extinguishing material is brought into direct contact with the fusible element, the arc-extinguishing material abrades or cuts into the surface of the fusible element, and thereby the fusible element is damaged. Thus, the fuse of this type has a drawback in that it mechanically breaks down due to the damage so caused. In addition, when the fusible element is fused by a great magnitude of current, the complete dispersion of metal vapors rising from the fused fusible element is prevented by the arc-extinguishing material surrounding the fusible element, preventing the creation of wide spaces between metal particles, and resulting in poor insulation. Thus, there is the risk of an arc discharge being caused again. Moreover, it is a very difficult operation to pack a particulate arc-extinguishing material, which deteriorates

the productivity of fuses of the type, into a small fuse's main body.

The present invention was made in view of the above drawback inherent in the prior art. So, the object thereof is to provide a reliable high breaking micro-fuse capable of securely breaking a great magnitude of current, as well as of maintaining a fusible element, used therein, free from damages when in proper operation.

In order to achieve this object, a high breaking capacity micro-fuse according to the present invention comprises an insulating body having a wall and a cavity defined by said wall in said body; a pair of conductive terminals extending outwardly from said cavity through said wall and being opposed to each other; a fusible element having both ends, one of said both ends being mechanically and electrically connected to one of said pair of terminals at the cavity side, said fusible element extending from said one of said pair of terminals to the other of said pair of terminals, the other of said both ends of said fusible element being mechanically and electrically connected to said other of said pair of terminals at the cavity side; and an insulating member having a hole which passes through said insulating member and through which said fusible extends, said insulating member having a shape by which a space is provided between the inner surface of said wall of said body and said insulating member in the condition that said insulating member is disposed in said cavity of said body.

The insulating member disposed in the cavity of the body functions to allow metal vapor, generated when the fusible element extending through the hole of the insulating member has been fused by an abnormal overcurrent flowing through the fusible element, to be released from the hole to the outer surface of the insulating member, and then to the inner surface of the wall of the body for dispersion, whereby the deposition density of metal vapors to the respective surfaces of the body and the insulating member is reduced, thereby making it possible to improve insulation resistance.

Fig. 1 is a perspective view of a fuse of the present invention before assembly;

Fig. 2 is a perspective view of the same fuse in which components have been incorporated;

Fig. 3 is a perspective view of the fuse of the present invention which has been completely assembled;

Fig. 4 is a longitudinal sectional view of the fuse of the present Invention; and

Fig. 5 is a cross-sectional view taken along the line A-A' of Fig. 4.

Referring to the drawings, a preffered embodiment of the present invention will be described.

In Figs. 1 to 5, a fuse's main body 1 is formed from a heat-resistant insulating material, such as ceramic, by embossing and baking the same material into a rectangular parallelepiped-shaped box which is 2 to 3 mm wide, 7 to 8 mm

long, and 2 to 3 mm high with the thickness of the materiel ranging from 0.5 to 1 mm.

Particularly speaking, slots are formed in longitudinal ends of the box 1 so as to allow terminals 3, 4 to extend outwardly from the box 1. A fusible element 6 is fixed between these terminals 3, 4 inside the box 1, and the terminals 3, 4 are electrically connected to electric circuits outside the box 1, respectively.

Partition walls 10, 11 are provided internally at the longitudinal ends of the box so as to prevent the inward movement of the terminals 3, 4, as well as movement of a cylindrical tube 2 provided in the box.

Solder-plated copper is used for the terminals 3, 4 and is press formed into a T-shaped lead wire, so as to prevent the withdrawal of the lead wire longitudinally of the main body 1 once a T-shaped end thereof is placed in the box-shaped main body 1. A heat-resistant insulating material such as ceramic is used for the cylindrical tube 2, and this material is embossed and baked, so as to be formed into a cylindrical tube having an outside diameter of 1 mm and an inside diameter of 0.5 mm, and as shown in Fig. 2, where this cylindrical tube 2 has a length allowing itself to just fit in the inside 5 of the box-shaped main body 1 after the fusible element 6 has been put therethrough.

The fusible element 6 is fixed to the terminals 3, 4 at the ends thereof, respectively, by soldering 8, 9. Afterward, a lid 7, made from the same material as that of the box-shaped main body 1, is placed on the top of the box-shaped main body 1 so as to close by sealing the upper

opening thereof, whereby a micro-fuse having an external appearance as shown in Fig. 3 is completed.

Thus, as can be seen in Fig. 5, the cross sectional shape of a cavity formed by the box-shaped main body 1 and the lid 7 placed thereon is rectangular, and spaces 12, 13, 14 and 15 are formed between the inner wall surface of the box-shaped main body 1, including the lid 7, and the outer surface of the cylindrical tube 2.

Even in the high breaking capacity micro-fuse as mentioned above, which has a simple construction in which the cylindrical tube with the fusible element extending therethrough is inserted in the box-shaped main body, it is possible to attain superior insulation resistance by allowing metal vapors to be dispersed into spaces 12, 13, 14 and 15 and to be absorbed by the inner wall surfaces of the box-shaped main body 1 and the lid 7, and the outer and inner surfaces of the cylindrical tube 2. It is also possible to obtain a performance good enough to securely break a great magnitude of current by means of an additional simple component such as a cylindrical tube 2 and simple assembling thereof. Moreover, there is no material surrounding the fusible element 6 in the cylindrical tube such as an arc-extinguishing material, and therefore the fusible element 6 is made free from restraint that would be imposed when an arc-extinguishing material is used. In addition, the surface of the fusible element 6 is also prevented from being abraded and damaged, whereby any mechanical breakage is prevented, thereby making it possible to obtain a highly reliable fuse.

A comparison test, between the high breaking capacity microfuse according to the present invention and a conventional fuse using an arc-extinguishing material, was carried out. With the high breaking capacity micro-fuse of the present invention, a proper current breaking operation was performed without any difficulty under the short-circuit breaking test condition voltage of 125 V, short-circuit current of 50 A and power factor of 0.7 which are stipulated under the overcurrent protection fuse standards UL198G, and showed the short-circuit breaking capacity performance similar to that of the fuse in which an arc-extinguishing material is used. Moreover, in a repeated overcurrent test, in which an exciting current equal to the rated current is repeatedly switched on and off for one second in an alternate fashion, the conventional fuse in which an arc-extinguishing material is used was fused after it had been switched on and off eight hundred and fifty-two times, while the high breaking capacity fuse of the present invention managed to endure the repeated energizations of ten thousands times, without fusing.

As is clear from the above description, the high breaking capacity fuse according to the present invention has a superior performance.

It should be noted that in order to form a space or spaces between the inner wall surface of the main body 1 and the lid 7, and the outer surface of the tube 2, the cross sectional shape of a cavity formed by the main body 1 and the lid 7 placed on the top of the main body 1, and the cross sectional outer surface shape of the tube 2 may be

various types of shapes, respectively. Moreover, it should be noted that the cylindrical tube 2 may consist of a plurality of cylindrical tubes which are disposed in series in the inside of the main body 1.

The present invention has been described in detail with reference to a certain embodiment thereof, but it will be understood that various and modifications can be effected within the spirit and scope of the invention.

CLAIMS

1. A high breaking capacity micro-fuse including:

an insulating body having a wall and a cavity defined by said wall in said body;

a pair of conductive terminals extending outwardly from said cavity through said wall and being opposed to each other; and

a fusible element having both ends, one of said both ends being mechanically and electrically connected to one of said pair of terminals at the cavity side, said fusible element extending from said one of said pair of terminals to the other of said pair of terminals, the other of said both ends of said fusible element being mechanically and electrically connected to said other of said pair of terminals at the cavity side; said high breaking capacity micro-fuse characterized by comprising;

an insulating member having a hole which is passing through said insulating member and through which said fusible extends, said insulating member having a shape by which a space is provided between the inner surface of said wall of said body and said insulating member in the condition that said insulating member is disposed in said cavity of said body.

2. A high breaking capacity micro-fuse as claimed in Claim 1, characterized in that said body and said member are made of ceramic material.

3. A high breaking capacity micro-fuse as claimed in Claim 1, characterized in that

said body comprises a box-shaped main body having a recess, and a cover covering said recess;

said pair of terminals being provided at longitudinal ends of said box-shaped main body,

said recess of said box-shaped main body having a rectangular shape in a cross section of said main body; and

said insulating member being a cylindrical tube.

4. A high breaking capacity micro-fuse as claimed in Claim 3, characterized in that said box-shaped main body, said cover and said insulating member are made of ceramic material.

5. A high breaking capacity micro-fuse as claimed in Claim 3, characterized in that said insulating member consists of a plurality of cylindrical tubes which are disposed in series in said recess of said box-shaped main body.

6. A high breaking capacity micro-fuse as claimed in Claim 3, characterized in that partition walls are provided internally at the longitudinal end portions of said box-shaped main body so as to prevent the movement of said insulating member in a longitudinal direction of said box-shaped main body.

7. A high breaking capacity micro-fuse substantially as described herein with reference to and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition K) H2G (GBX,GDB,GDE)

(ii) Int Cl (Edition 5) SELECTED US SPEC IN IPC SUB-CLASS H01H

Search Examiner
MISS J E EVANS

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
4 NOVEMBER 1991

Documents considered relevant following a search in respect of claims 1-7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
PA	GB 2233512 A (SOC) 9 January 1991, whole document	1 at least
X	GB 1200707 (WESTINGHOUSE) see Figure 2	1 at least
X	GB 1200702 (WESTINGHOUSE) see Figure 2	1 at least
X	GB 811962 (WESTINGHOUSE) see Figure 7	1 at least
X	GB 396197 (FERGUSON) whole document	1 at least

Category	Identity of document and relevant passages	Relevant to claim(s

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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